

16 working together to preserve heat and insulate against the convective cooling effects of ambient air.

Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing an illustration of the presently preferred embodiment of this invention. Various other embodiments and ramifications are possible within its scope. For example, although this disposable system invention is applied to my previous blood warmer system (U.S. Patent number 6,608,968 B2), it would provide significant improvement to several other currently marketed in-line blood warmers.

Thus the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

Claims: What is claimed is:

1. A passively insulated and actively warmed disposable outlet patient flow line system for in-line blood/fluid warmers comprising:

A.) a flexible tube flow line made of polyvinyl chloride or other resinous material has a central blood-carrying tube about 0.12 inch inside diameter

and a wall thickness of about 0.04 inch, and is supported inside a larger tube which is co-extruded with said central tube and has an outside diameter of about 0.37 inch and a wall thickness of about 0.04 inch, said central and outer tubes being interconnected by co-extruded webs about 0.04 inch thick which appear in cross section as a planar diametrical web across the entire cross section with the exception of said central tube's lumen, wherein an annular space between said central and outer tubes is filled with heat insulative still air,

B.) said flow line having an inlet end adapted to connect to the warm blood outlet of an in-line blood warmer apparatus and an outlet end adapted to a patient intravenous site,

C.) a flexible elongated electrical resistance heater segment located within each half of said annular air space,

D.) said heater segments extending in length from about one half to nine tenths the length of said flexible tube flow line, and extending all the way to said outlet end of said flow line,

E.) said internal heater segments being electrically and mechanically joined together at said outlet end of said flow line forming a series electrical resistance heater,

F.) the two proximal ends of said electrical resistance heater being electrically and mechanically adapted to be removably connected to a temperature controller located in said blood warmer apparatus,

C.) said electrical resistance heater being maintained at a controlled temperature of about 42C by a controller mounted inside said blood warmer apparatus,

whereby blood is maintained at normothermic temperature near 42C while passing slowly at very low flow rates through said patient flow line system.

2. A system according to claim 1 wherein said electrical resistance heater is a bare metal wire about 0.001 inch to 0.010 inch in diameter.

3. A system according to claim 1 wherein said electrical resistance heater is a bare metal ribbon about 0.0005 to 0.003 inch thick and about 0.10 to 0.30 inch wide.

4. A system according to claim 1 wherein said electrical resistance heater is made of insulated wire.

5. A system according to claim 1 wherein said electrical resistance heater is made of a metal with a high temperature coefficient of resistance such as nickel or an alloy such as 70% Nickel, 30% Iron.

6. A system according to claim 2 wherein said electrical resistance heater segments are made by winding said wire in a tightly spaced helical form on elongated rods or tubes about 0.1 inches in diameter,

A.) said rod or tube being made of a flexible insulator such as plastic, whereby a much longer length of wire and much larger heat transfer area may be achieved.

7. A system according to claim 2 wherein said electrical resistance heater segments are made by winding said wire in a tightly spaced quasi helical form on elongated, flexible strip shaped insulators about 0.03 inch thick and about 0.10 to 0.25 inch wide, whereby a much longer length of wire and much larger heat transfer area may be achieved.